REMARKS

In the office action, the examiner rejected claims 1-8 and 10-13 as being obvious in light of the King article ("King") when combined with the Taner patent ("Taner"). Applicant respectfully traverses these rejections, and requests that the examiner reconsider the application in the light of the following comments.

Applicant contends that the examiner has misunderstood the teachings of King and Taner, or the teachings of the present application, or both. To assist with technical interpretation and comparison, the applicant submits an expert affidavit with this response.

King discloses a method for using acoustic waves to evaluate "material properties" of a medium, where typical material properties are attenuation, wave velocity and reflectivity at the surface. (See King, first paragraph.) Taner discloses a method for predicting lithology of the subsurface from seismic and well log data, lithological classes being, for example, shale, sand and subclasses thereof. (See Taner, claim 1 and col. 9, lines 31-35.) Applicant discloses a method for obtaining a data volume for a petrophysical property from a few well logs and 2D or 3D seismic data, a "petrophysical property" being, for example, gamma ray response, resistivity, porosity, permeability, density or shale volume fraction. (See claims 1 and 7.) A difference between the disclosures of the three documents is thus already apparent..

Applicant's claim 1 reads as follows:

1. A method of converting seismic traces to petrophysical properties comprising:

(a) deriving a combined log seismic response filter from at least one petrophysical log in a well and at least one seismic trace substantially near at least one well;

(b) convolving the combined log seismic response filter to convert the seismic traces to at least one log of petrophysical properties;

(c) outputting at least one log of petrophysical properties from step (b).

Applicant believes that neither King nor Taner discloses or suggests either step (a) or step (b) of the applicant's claim 1.

Applicant teaches a method to directly convert seismic data to reservoir property data. (¶ 7) This is to be contrasted with prior art methods that derive a seismic *attribute* such as seismic amplitude or trace-to trace correlation coefficients, and then empirically calibrate the attribute to a desired reservoir (petrophysical) property. (¶ 5) Applicant's method incorporates the constraint of available well data, and enhances the relatively low vertical resolution of seismic data to approach the vertical resolution of well logs, subject to the Nyquist frequency of the seismic data. Applicant's method is based on rigorous wave physics and petrophysics principles rather than devices such as empiricism or neural network methods. (See ¶ **26**, and Background section.) The present application shows formulas and derivation for a preferred embodiment of the applicant's method. Applicant's claim 1, steps (a) and (b), summarize this method of the applicant.

King does not teach his method as being suitable to obtain petrophysical properties. His method is for inferring wave properties, i.e., how the acoustic wave interacts with the medium. King does not teach how to derive "a combined log seismic response filter" (step (a) of claim 1) or even suggest a need for one. The examiner may have been misled by the box labeled "bandpass filter" in King's Fig. 1. This refers to King's measuring device. A bandpass filter passes through a certain band of frequencies. In King's case, the filter will depend on characteristics of the particular physical measuring device used. King's filter, $M(\omega)$, might be compared to the low frequency seismic response filter $w_l(t)$ or the high frequency logging tool response filter $w_h(t)$ that appear in Eqs. (1) and (2) of the present application (except that the present inventive method is applied in the time domain while King's method is applied in the frequency domain, as can be seen by the independent variables). However, that is as far as one can extend the comparison. There is nothing in King to

even suggest the combined log seismic response filter of the applicant's claim 1, such as the filter *c(t)* that can be derived from the applicant's Eqn. (4).

Moving to step (b) of claim 1, the examiner may have been misled by King's convolving impulse signals with the transfer function of the medium. (Abstract) King's use of the convolution operation comes in his Eqn. (1):

$$Y(\omega) = X(\omega)H(\omega)M(\omega)$$

where $X(\omega)$ is the spectrum of the incident pulse, $H(\omega)$ is the transfer function for a layered medium which characterizes the material properties (not petrophysical properties as specified in the present application and claim 1) of the medium, and $M(\omega)$is the transfer function of the measuring device. This has little, if anything, to do with performing the applicant's step 1(b). It is also noted that King uses the standard matrix equation solution technique called singular value decomposition. This technique is also used by the applicant, but in performing an unrelated step.

As best as the applicant can deduce, the examiner cites Taner in an attempt to bridge a gap in King, the gap being that King does not teach a method for obtaining petrophysical properties, and does not teach using seismic traces in the process. The applicant believes he has demonstrated much more substantial gaps in King in the preceding discussion. Nevertheless, the lithology characteristics that Taner seeks to obtain are as far or farther removed from the applicant's petrophysical properties as King's "material properties." (See discussion above.) Taner cannot help supply what is lacking in King.

Regarding step (c) of the present application's claim 1, every computer implemented method must of course output the result, but since step (c) specifies that the result must be a petrophysical (reservoir) property, step (c) is also not disclosed in either King or Taner.

The applicant further observes that King's method is performed entirely in the frequency domain, as is indicated by the independent variable in his equations being frequency, ω. Attention is directed to paragraphs 34 and 35 of the present application

where it is explained that to perform the method in the frequency domain results in physically and mathematically impossible solutions, essentially the problem resulting from division by zero. It is a main inventive feature of the present invention to circumvent this problem by performing the process in the time domain. To highlight this feature, the applicant submits herewith a claim amendment adding a new dependent claim 15.

In summation of the arguments presented above, it would appear that the examiner has found two references that involve such things as seismic data, well logs, data filters, the convolution operation, and singular value decomposition. However, these are common things to be found in many scientific publications, and their mere presence does not signify a unique technology.

In addition, the applicant submits herewith the expert affidavit of Hezhu Yin, who gives his opinion on technical aspects of the arguments presented herein from the standpoint of a skilled practitioner of the art, thus removing assessments made herein other than legal conclusions from the realm of "lawyer argument" or lay opinion.

CONCLUSION

Each of the claims of the application is limited to Applicants' inventive method for directly converting seismic data to petrophysical property data in a rigorous application of certain physics and petrophysics principles. Each of these claims is believed to be patentably distinct from all known prior art, including all art cited by the examiner. Therefore, Applicants respectfully request allowance of all pending claims including the additional claim added by amendment herewith (1-15).

If the examiner wishes to discuss this application with counsel, please contact the undersigned.

Respectfully submitted,

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